

Book Review

Enzymatic reactions in organic media, ed. A. M. P. Koskinen & A. M. Klivanov, Blackie Academic and Professional, London, 1996, xiii + 314 pp., price UK£75.00. ISBN 0 7514 00259 1.

It is now no longer surprising to find that enzymes may be used successfully in organic media. It should not ever have been surprising that some enzymes, which normally exist in hydrophobic environments, for instance in biological membranes, or which catalyse the modification of hydrophobic substrates, retained activity in organic solvents. There have been two international meetings on the use of enzymes in non-conventional media and another will be held in 1998. Volumes of conference proceedings tend to satisfy only the specialist and a comprehensive review of the state of knowledge was overdue. This volume fills the need very satisfactorily.

The most interesting and intellectually challenging aspect of the use of enzymes in organic media is the study of the interactions of enzyme proteins with the media, in particular the factors which tend to inactivate the enzymes and the means by which inactivation may be limited or prevented. Once it has been established that biocatalysts can operate very effectively in organic media it is not surprising that very many biotransformations may be conducted enzymatically in those media. There is a danger in producing a survey of the subject that the volume will have two parts, a fascinating section dealing with protein-solvent interactions and a rather less than fascinating catalogue of the reactions that have been observed to occur in those solvents. The editors of this volume have not managed to avoid that danger.

After an introductory scene-setting chapter by Koskinen, the book begins excellently. Patrick Adlercreutz describes the practical fundamentals such as the choice of solvents, comparison of the various ways in which biocatalysts may be used in organic media, and the effects of water. He also mentions other non-conventional media such as critical and near-critical fluids and the use of gaseous substrates in a satisfying review. Yang and Russell follow with a survey of the fundamentals of non-aqueous enzymology at the molec-

ular level, describing the effects of water on enzyme activity, the effects of solvents on the water associated with the enzyme, direct effects of solvents on enzymes, then effects of solvents on substrates and products. Zaks continues and amplifies this topic, in a chapter on new enzymatic properties occurring in organic media, such as altered substrate specificity, stereoselectivity, regioselectivity and chemoselectivity. In the same chapter he moves on to a consideration of the factors which determine thermal stability in organic media. This fascinating chapter raises more questions than it answers and stresses the impossibility of producing unifying theories to explain the effects of all solvents on all proteins.

I found the next four chapters much less satisfying. They review academic literature describing observations of enzyme-catalysed reactions in organic media. The four groups of topics are enzymatic resolutions of alcohols, esters and nitrogen-containing compounds, the regioselectivity of hydrolases, hydrolase-catalysed asymmetric transformation and peptide synthesis. For some readers these may be potential gold mines of novel information but I suspect that the information may be accessible from other sources.

The final two chapters restore the high standard: Jenya Vulfson and colleagues provide a survey of innovative strategies for using enzymes in non-aqueous media, with stress on means of increasing productivity. The chapter describes applications of 'solvent-free' synthesis, where one of the substrates is, in effect, the solvent, the use of eutectic mixtures and means of introducing continuous bioreactors. Sheldon continues the theme of applicability by surveying the now rather impressive list of enzymatic conversions which have been conducted on a large scale in non-aqueous media.

Finally, Alex Klivanov, who can claim reasonably to be the father of the study and application of enzymes in organic media, provides an optimistic epilogue, pointing out that this area of biotechnology has grown in a decade from a curiosity into a fast-moving and productive area of study. There is no reason to suppose that progress will decelerate in the next decade.

C. Bucke